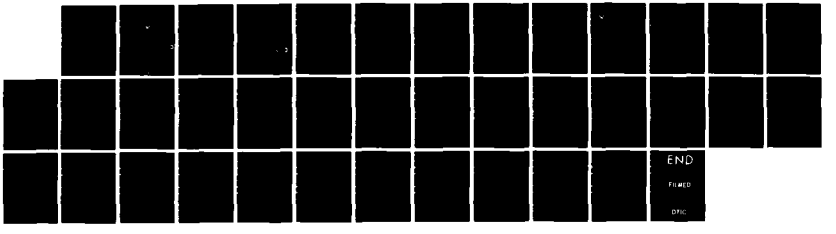
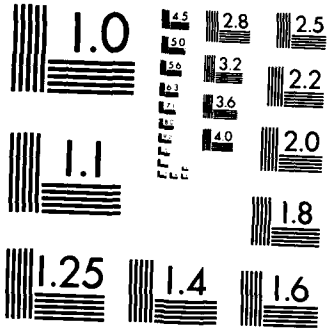
AD-A156 131 INFLATION AND THE CAPITAL BUDGETING PROCESS(U) AIR COMMAND AND STAFF COLL MAXWELL AFB AL R CANNY APR 85 ACSC-85-0375 1/1

UNCLASSIFIED F/G 5/3 NL





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

(2)

AIR COMMAND AND STAFF COLLEGE

STUDENT REPORT

INFLATION AND THE CAPITAL BUDGETING PROCESS

MAJOR REGIS CANNY 85-0375

"insights into tomorrow"

DISCLAIMER

The views and conclusions expressed in this document are those of the author. They are not intended and should not be thought to represent official ideas, attitudes, or policies of any agency of the United States Government. The author has not had special access to official information or ideas and has employed only open-source material available to any writer on this subject.

This document is the property of the United States Government. It is available for distribution to the general public. A loan copy of the document may be obtained from the Air University Interlibrary Loan Service (AUL/LDEX, Maxwell AFB, Alabama, 36112) or the Defense Technical Information Center. Request must include the author's name and complete title of the study.

This document may be reproduced for use in other research reports or educational pursuits contingent upon the following stipulations:

-- Reproduction rights do not extend to any copyrighted material that may be contained in the research report.

-- All reproduced copies must contain the following credit line: "Reprinted by permission of the Air Command and Staff College."

-- All reproduced copies must contain the name(s) of the report's author(s).

-- If format modification is necessary to better serve the user's needs, adjustments may be made to this report--this authorization does not extend to copyrighted information or material. The following statement must accompany the modified document: "Adapted from Air Command and Staff Research Report (number) entitled (title) by (author) ."

-- This notice must be included with any reproduced or adapted portions of this document.

REPORT NUMBER 85-0375

TITLE INFLATION AND THE CAPITAL BUDGETING PROCESS

AUTHOR(S) MAJOR REGIS CANNY, USAF

FACULTY ADVISOR MAJOR ROBERT HEATH, USAF, ACSC/EDCM

SPONSOR LT COL ROBERT E. PIZZI, USAF
DEPARTMENT OF MANAGEMENT (DFM)
USAF ACADEMY, CO 80840

Submitted to the faculty in partial fulfillment of requirements for graduation.

AIR COMMAND AND STAFF COLLEGE
AIR UNIVERSITY
MAXWELL AFB, AL 36112

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION/AVAILABILITY OF REPORT DISTRIBUTION STATEMENT A Approved for public release Distribution Unlimited
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S) 85-0375	5. MONITORING ORGANIZATION REPORT NUMBER(S)
6a. NAME OF PERFORMING ORGANIZATION ACSC/EDCC 6b. OFFICE SYMBOL (If applicable)	7a. NAME OF MONITORING ORGANIZATION
6c. ADDRESS (City, State and ZIP Code) MAXWELL AFB, AL 36112	7b. ADDRESS (City, State and ZIP Code)
8a. NAME OF FUNDING/SPONSORING ORGANIZATION 8b. OFFICE SYMBOL (If applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
8c. ADDRESS (City, State and ZIP Code)	10. SOURCE OF FUNDING NOS. PROGRAM ELEMENT NO. / PROJECT NO. / TASK NO. / WORK UNIT NO
11. TITLE (Include Security Classification) INFLATION AND THE CAPITAL BUDGETING PROCESS	
12. PERSONAL AUTHOR(S) CANNY, REGIS, MAJOR, USAF	
13a. TYPE OF REPORT 13b. TIME COVERED FROM _____ TO _____	14. DATE OF REPORT (Yr., Mo., Day) 1985 APRIL 15. PAGE COUNT 36
16. SUPPLEMENTARY NOTATION	
17. COSATI CODES FIELD / GROUP / SUB. GR.	18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

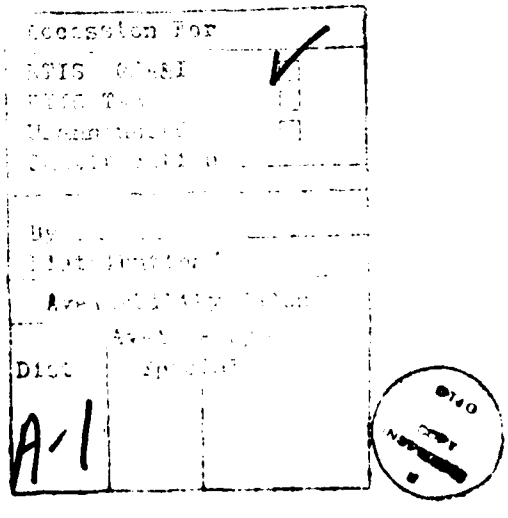
This report performs first a theoretical review of why and how inflation needs to be considered in the capital budgeting process. The Net Present Value (NPV) capital budgeting equation model is modified extensively to account for the effects of inflation. Secondly, a limited review of the capital budgeting techniques of 3 major retailers is performed to determine the use of inflation adjusted techniques in actual practice. The report concludes with a comparison of the theoretical and empirical ways of dealing with the effects of inflation in the capital budgeting process.

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☒ DTIC USERS ☐	21. ABSTRACT SECURITY CLASSIFICATION UNCLASSIFIED
22a. NAME OF RESPONSIBLE INDIVIDUAL ACSC/EDCC Maxwell AFB Al 36112	22b TELEPHONE NUMBER (Include Area Code) (205) 293-2483 22c OFFICE SYMBOL

PREFACE

This report analyzes why and how inflation is considered in the capital budgeting process from a theoretical as well as an empirical perspective. The material in this report was requested by and will be submitted to the United States Air Force Academy, Department of Management, Accounting and Finance Division. In addition, this paper will be available to each course attendee as a primer and source of information for informative unclassified briefings on this subject.

The net present value (NPV) capital budgeting model is used extensively in this report and the Consumer Price Index - Urban (CPI-U) and the Wholesale Price Index (WPI) are both used to monitor the levels of inflation over time. This type of capital budgeting model and both types of indicies are used when firms bid for aircraft procurement contracts and when a government entity such as the Army and Air Force Exchange Service (AAFES) is considering a commercial expansion. An indepth review of why and how inflation should be considered in the NPV claculations of the latter will be explored.



ABOUT THE AUTHOR

Major Regis Canny has served as a comptroller officer and as an assistant professor. He began his military career as an auditor and transferred to the faculty of the USAF Academy where he taught courses in finance, accounting, tax, management and economics. His assignment prior to attending Air Command and Staff College (ACSC) was as an accounting and finance staff officer, Comptrollership for Nonappropriated Funds, Directorate of Morale Welfare and Recreation, Air Force Manpower and Personnel Center, Randolph AFB Texas. He holds a BSBA degree in accounting (SUMMA CUM LAUDE) from Duquesene University, Pittsburg, Pa. and an MBA degree in accounting and finance from the University of Colorado, Colorado Springs Co. In addition, he is a Certified Public Accountant (CPA) in Colorado as well as a Certified Managerial Accountant (CMA). Upon completion of ACSC (Class of 1985), Major Canny will assume the duties of the comptroller for Andersen AFB, Guam.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

TABLES

EQUATIONS

EXECUTIVE SUMMARY

Part of our College mission is distribution of the students' problem solving products to DoD sponsors and other interested agencies to enhance insight into contemporary, defense related issues. While the College has accepted this product as meeting academic requirements for graduation, the views and opinions expressed or implied are solely those of the author and should not be construed as carrying official sanction.

"insights into tomorrow"

REPORT NUMBER 85-0375

AUTHOR(S) MAJOR REGIS CANNY, USAF

TITLE INFLATION AND THE CAPITAL BUDGETING PROCESS

I. Purpose: To determine why and how the effects of inflation should be, and are being incorporated into the capital budgeting process for the purpose of making an economic decision.

II. Problem: Prior to the mid-1970s, inflationary impacts were relatively mild and generally ignored in capital budgeting models that determined the present value of future net cash inflows, adjusted for time and project risk, in comparison to the cash outflow to purchase the investment. Subsequent to this time; however, the overall effects of inflation have been severe (until recently, i.e. the last three years) from the standpoint that real cash flows were less than expected resulting in inadequate investment decisions. To gauge the effects of inflation on investment decisions requires the review of both the specific price index and the general price index applicable to the decision. In addition, the risk associated with how inflation might vary over time is also a consideration. As a result of these increased environmental complexities, managers need to know how inflation should be and is being considered in investment strategy decisions.

CONTINUED

III. Objectives: This report contains three major objectives. They are (1) to determine what bearing inflation has on an economic decision, (2) to develop a theoretical foundation for the explicit recognition of inflation in a capital budgeting model and (3) to examine how inflation adjusted decisions are made in practice.

IV. Data: An extensive literature review was performed to develop the theoretical basis for why and how inflation should be considered in an investment decision. Using mathematical and statistical theorems, an inflation-adjusted net present value capital budgeting model was developed that provides for both price level adjustment and inflation risk. This theoretical model was compared to what actually takes place in the area of retail investments. The latter data was obtained through a limited survey and the retail industry was selected since this analysis could then be related to similar decisions made by the Army and Air Force Exchange Service (AAFES) - itself the eighth largest retailer in the United States.

V. Conclusion: The literature supports from a theoretical perspective the inclusion of both price level and inflation risk adjustment factors in the capital budgeting process to ensure that valid economic investment decisions are made. From an empirical standpoint however, only specific price level adjustments are made to future cash flow projections and no consideration is given to inflation risk over time.

VI. Recommendation: Despite the theoretical need to incorporate overall inflation risk into the capital budgeting process, a retail organization such as AAFES would not be disadvantaged vis-a-vis other retailers if only specific price level adjustments are made to future projected cash flows in an investment decision.

Chapter One

INTRODUCTION

BACKGROUND OF PROBLEM

A variety of formal capital budgeting models have been developed to aid managers in their decision-making process. Each model explicitly recognizes some environmental factors, whereas other factors are simplified or eliminated altogether. A manager can select a model that recognizes factors perceived to be critical and simplifies or ignores other factors. The purpose of this research is to examine such models from a theoretical standpoint so as to analyze the effects of inflation. The use of such inflation adjusted models from an empirical aspect will also be assessed.

In past years, several surveys have been conducted to determine which capital budgeting models managers were using in making their firm's investment decisions. Mao in 1970 concluded that the primary models used were the payback model and an accounting profit criteria, in spite of the theoretical support for the discounted cash flow models. [8:359] Fremgren in 1973 surveyed major U. S. firms to determine which capital budgeting models they utilized in investment decision-making. Seventy-six percent of the firms utilized a discounted cash flow capital budgeting model. (This model is discussed in Chapter Two.) The second most popular model, the payback model, was utilized by 67 percent of the firms. However, only 14 percent of the firms utilized the payback model as the primary investment model. [5:20] In 1978, Schall, Sundem and Geijsbeek found 96 percent of firms surveyed used either the internal rate of return or the net present value model, or both. Comparison of their data with other surveys suggests that managers are now utilizing increasingly more sophisticated capital budgeting techniques than during past years. [11:286]

What is interesting to note about the early studies on capital budgeting models was that the rate of inflation at this time was about two percent and relatively stable. As a result, a manager could predict the rate of inflation with relative ease. The inflation rate had minimal impact on the cash flows to be predicted for a specific project when compared to the impact of the uncertainty of the cash flows, technological changes, project demand, and project life. The effect of inflation apparently did not warrant consideration in the investment decision, since the above survey data found no explicit recognition of inflation by managers. In essence, one could argue that the effort involved in using a model that explicitly incorporated inflationary factors when inflation was low and stable was

greater than the benefit to be gained from such a model. Therefore, managers either chose not to consider inflationary factors or implicitly considered the potential inflationary effects at some point in their decision-making process.

As the indices in Table I indicate, the rate of and uncertainty about inflation has increased in recent years. The impact of inflation on the investment decision has become relatively more significant, but has diminished somewhat in the last two to three years. The uncertainty about the real cash flows has increased as a result of varying inflation rates.

Product demand may vary as a result of changes in specific prices, (specific inflation, as indicated by the CPI-U and WPI indices) and in the general purchasing power of the dollar (general inflation as shown by the GNP Deflator Index). If the general rate of inflation is zero, but relative prices change, a firm will adjust its consumption in favor of the less expensive product, ceteris paribus. On the other hand, when the purchasing power of the dollar varies, the quantity that can be purchased for a given number of dollars also varies. As a result, the decisions environment and decision task become more complex when specific and general inflation indices are considered.

In addition when an investment project spans several time periods, additional complexities exist. The increase in the uncertainty about the real cash flows in future periods will complicate the capital budgeting task even more. As a result of the increased environmental complexity induced by inflation and inflation risk, managers may decide that inflation now warrants consideration in the investment decision strategy.

THEORETICAL IMPACTS OF INFLATION

To illustrate the impact of inflation on capital investment/budgeting decisions, the Beach and Mitchell contingency model will be used. [2:439] This model focuses on the selection of decision strategies where the cost/benefit analysis is contingent upon the individual decision maker and the environmental variables. In this model, the individual decision maker is influenced by the decision problem and environmental factors when selecting the level of a decision strategy. The three levels of decision strategy are no-analytic, unaided analytic, and aided analytic. The first two levels are implicit levels; that is, the decision maker is using his mental processes only, or a heuristic decision strategy such as a coin toss. The last level involves the use of a systematic procedure to analyze the decisions problem.

The four factors comprising the decision problem are unfamiliarity, ambiguity, complexity, and instability. Consider the effect of inflation on two of the four decision problem factors in the Beach and Mitchell model. Inflation will increase the number of components, i.e., complexity, of the decision problem, at the very least. The project analysis will involve more

Chapter Four

INFLATION ADJUSTED MODELS IN PRACTICE

BACKGROUND

Having developed the theoretical foundation of why and how inflation must be considered in an investment decision, the final step will be to determine if this is done in practice. Not wishing to determine this in a general sense, this report will review a specific industry that might have some parallels with an Air Force entity. In this respect, the retail industry was selected since investment decisions made by these firms are similar in nature to those of the Army and Air Force Exchange Service (AAFES). Table 2 shows the relative sales value of this organization in comparison to the nine other top retail firms for the most recent sales year for which data is available. Capital budgeting decision information was obtained for three of the top seven (K-Mart, J. C. Penny and Woolworth's) by means of a survey shown in Appendix One. The survey data relating only to inflation-adjusted capital budgeting decisions, is summarized in Appendix Two.

Ten Largest Retailers in the US
Based on 1983 Retail Sales
(Dollars in Billions)

Rank	Retailer	Sales Dollars
1	Sears	$20.4
2	K-Mart	18.6
3	J. C. Penny	12.1
4	Federated	7.2
5	Dayton-Hudson	7.0
6	Montgomery Wards	6.0
7	Woolworth's	5.5
8	AAFES	4.8
9	Wall-Mart	4.7
10	May Company	4.2

(Source: HQAFMPC/MPCSCA, Mr. Hicks AV 487 - 6671)

Table 2

consider data beyond that point, the manager could require that the costs are recovered earlier. The requirement of payback in 'x' years previously would be replaced with 'x - k' years.

Each of the inflation risk heuristics, in effect, eliminates the consideration of cash flows in distant future periods. Another strategy to counter the effects of inflation risk would be to introduce projects that potentially reduce the firm's susceptibility to inflation rate fluctuations.

One way a firm can counter the effects of inflation risk is to incorporate projects that are readily adaptable to environmental changes. Multipurpose projects and stage products would increase adaptability relative to single purpose projects. Because of the multiple options available to the firm in future periods, the risk to a firm of undertaking these projects is decreased.

An alternative strategy that could decrease susceptibility to inflation is the implementation of capital intensive, rather that labor intensive, projects. The capital intensive project requires an initial outlay to purchase a long-term asset. The depreciation expenses are determined initially and inflation fluctuations will not affect the expense. The labor intensive project on the other hand, affords a firm greater flexibility. But, the labor intensive project is far more susceptible to unexpected price fluctuations. Cash flow projections are made initially when the project is being considered for implementation. If these cash flow predictions are initially underestimated, greater expenses than anticipated would result. Thus, the increased flexibility of labor intensive projects comes at a higher cost.

SUMMARY

As was shown in Chapter Two, a complex formula must be employed to account for inflation in the capital budgeting process. This chapter discussed what happens if the firm ignores certain inflation characteristics, and it also developed several heuristics dealing with inflation risk. By ignoring either general and/or specific price level effects, or assuming they were equal, a manager could make an incorrect investment decision. This would result when the cash flow projections did not properly reflect the inflationary trends. In the second part of this chapter, the theoretical underpinnings of why inflation needs to be considered in the risk factor (denominator of the NPV model at Equation (1)) was highlighted. Given a through grounding in the "school solution" of why and how the effects of inflation should be incorporated into the capital budgeting process, it is now time to see what is in fact the practice. In Chapter Four, how inflation adjustments are made in the retail industry will be reviewed as well as where this data might be applicable in the Air Force.

INFLATION RISK HEURISTICS

Consider the possible effects of inflation risk on investment decisions. The net present value model compares the initial investment with the resulting future cash flows. The initial investment is known for certain. The depreciation expense and the resulting tax savings are also known for certain at the time of acquisition. The future cash flows can only be estimated. The longer the project operates in the future, the more uncertain each future cash flow becomes.

In addition to the uncertainty about the cash flows, there is uncertainty about the rate of inflation, both specific and general. The variance about the expected rate of inflation also increases over time. If there is a positive correlation between the cash flow estimate and the rate of positive inflation, then the variability surrounding the cash flow will increase. The increased uncertainty about the cash flow will make long-run investment decision making more difficult due to the decreased reliability of the signal from the model.

With inflation, the uncertainty about future periods is increased. There are specific price level changes that occur with production factors of a project. There is also a general price level change reflecting the change in the overall purchasing power of a dollar. Each of these factors compounds the uncertainty associated with future periods. Fama and Schwert found that the market appears to respond only to the common part of expected inflation of different goods. [4:186] Cooley, Roenfeldt and Chew assert that the inflation risk premium would increase the discount rate to counter the uncertainty about inflation. [3:84]

Because of the effects of inflation, the risk premium could possibly reduce the discount rate. Two key factors must be estimated before the inflation risk premium can be made. First the relationship between the market return and the general rate of inflation must be known. Then the covariance between the rate of return for the project and the general rate of inflation must be known. In general, projects with returns positively related to the general inflation rate have a lower required rate of return and discount rate than projects with a negative correlation. Each project must be individually analyzed to determine the appropriate inflation risk premium. If a manager would prefer not to explicitly recognize inflation in an investment model, several alternatives exist whereby a firm might recognize the effects of inflation risk in investment decisions. One way to reduce the uncertainty of future periods is to reduce the confidence placed on those future period returns. In effect, the intolerable level of uncertainty is reached by the manager at an earlier point in time. Thus, management would not plan beyond that point. In effect, the increased future period uncertainty would induce managers to decrease the length of the planning horizon.

An alternative heuristic that would have the same effect as the shortened planning horizon is a payback constraint. The intolerable level of uncertainty is reached also at an earlier point in time. Rather than

for example, a project has a positive net present value. The model the firm is using is a constant rate net present value model. If the general rate of inflation was underestimated in all years, the discount rate would be understated and a bias toward overinvestment could result. Both errors together could compound the misstatement of proposal value. Each case must be considered individually; however, since an underestimation of both the general and specific inflation rates could result in either a bias in favor of overinvestment or a bias in favor of underinvestment depending upon the magnitude of the estimation error.

Management may assume that the specific rate of inflation is positively correlated with the general rate of inflation, and simplify their investment model by substituting the general rate of inflation for the specific rate. In this instance, the firm is using a general price level adjusted net present value model, which adjusts all cash flows by a general price level index. The discount rate contains the same general price level adjustment. Depending upon the sign and magnitude of the forecast error (in this case the difference between the general inflation index and the specific cash flow index) the signal generated by the model could suggest an action that is inconsistent with the true value of the investment. Because inflation affects all firms, it is expected that the majority of firms are adjusting their capital investment strategies to explicitly recognize the effect of specific and general inflation.

Carsberg and Hope investigated the inflationary adjustments made in investment strategies by British firms. [1:15] They found that the majority of the surveyed firms were incorrectly adjusting for inflation in their investment decisions. The firms were, for example, adjusting their cash flows without adjusting their discount rate for inflation. (More on this in Chapter Four) The internally inconsistent inflation adjustment could have produced a distorted investment signal. On the average, Carsberg and Hope found that the investment strategies followed by firms introduced a bias towards underinvestment. Nelson stresses the need for internal consistency within the capital budgeting model, that is, real cash flows should be discounted by a real discount rate and nominal cash flows should be discounted by a nominal rate. [9:930] If this internal consistency is absent, a bias could be introduced into the capital budgeting decision process.

To summarize, there is reason to expect that the effects of inflation may induce managers to consider inflation in their investment decisions. If the consideration is not carefully developed, a bias may be introduced into investment decisions. The consideration of inflation may be warranted beyond the incorporation of specific and general price level adjustments into the capital budgeting model. The consideration of inflation risk is also warranted. The effects of inflation risk and possible inflation risk heuristics available to managers are discussed in the next section.

Chapter Three

THE EFFECTS OF INFLATION ON THE FIRM

BACKGROUND

General inflation is an increase in the general price level, thereby causing a decline in the purchasing power of the dollar. Specific inflation is the change in the relative prices of products. Both specific and general inflation impact the overall operations of a firm and capital budgeting decisions in particular. The inadequate consideration of inflation may lead to suboptimal decisions that, in turn, could affect performance. Thus, managers may undertake various strategies to counter inflation and inflation risk effects. The two sections of this chapter discuss possible biases that may be introduced by model selection and the inflation risk heuristics a firm may implement in an attempt to counter the effects of inflation.

MODEL SELECTION BIAS

In Chapter Two, an inflation adjusted net present value model was developed (Equation (7)). In this model, both specific and general rates of inflation were explicitly recognized. In addition, the explicit consideration of inflation risk was incorporated into the model. Certain simplifications to this model can be made. The manager could omit the explicit recognition of inflation risk from the model, make the assumption that both the general and specific inflation rates are constant over time, or assume that the general inflation rate reasonably approximates the specific inflation rates and make the appropriate model adjustments. Each of these simplifications could introduce bias into the investment decision and thereby affect a firm's performance as the rate of specific and general inflation increases. The elimination of inflation risk factors from the investment model will be discussed in the second section of this chapter.

Both general and specific inflation rates vary over time. Explicit recognition of this variation should result in a relatively more accurate signal from the investment model. Management may decide, however, that the explicit recognition of this variation is unwarranted. Depending upon the estimate of the specific and general inflation rate, a distortion of the signal may occur. If the estimates are a reasonable approximation of the actual rates of inflation, the distortion will be less than when the estimates become more inaccurate. The sign and magnitude of the error could bias the signal generated toward overinvestment or underinvestment. Assume,

$$NPV_j = -C_o + \frac{\sum_{i=1}^{I} \left[\left[\prod_{n=1}^{i} (1+l_n) \right] CI_i - \left[\prod_{n=1}^{i} (1+O_n) \right] CO_i \right] (1-t) + D_i t}{\prod_{n=1}^{i} = 1 \quad 1+r_n^* + cov_n\,(p_n, i_n) + cov_n(j, \bar{r}_m) - \frac{cov_n(p_n, j)}{a_n} \cdot z} \tag{7}$$

where $$z = \frac{r_{m,n} - r_n^* - cov_n(r_m, \dot{p}_n)}{\sigma_\pi^2(\bar{r}_m) - \frac{cov_n(r_m, p_n)}{a_n}}$$

The above model considers both inflation and inflation risk. That is to say the cash flows are adjusted by specific price level indices and the discount is adjusted for the general price level changes, and also for inflation risk.

SUMMARY

This chapter began by presenting a simple NPV model that compared a project's cost with its discounted net cash inflows given a rate that considered the project's overall risk. However, this model did not consider how inflation impacts first the cash flows associated with the project and secondly the project's risk. Using mathematical and statistical theorems, substantiated in the literature, a revised NPV model was developed. Albeit complex, this model accounts for all inflation adjustment factors discussed in Chapter One. From a theoretical standpoint then a proper investment decision can be made that explicitly provides for the effects of inflation if Equation (7) is used. However, insufficient consideration of relevant inflation information could adversely affect a firm's investment decision. These potential effects are discussed in Chapter Three.

a_n is the proportion of risky investments in the economy at time n, and all other terms are as previously defined.

Each calculation made in this discount rate formula must generate a nominal value. The project's return and the overall market return are both presented in nominal terms; therefore, the covariance is nominal. This term is a project specific parameter that varies in accordance with the project's expected return.

FURTHER THEORY ON THE DISCOUNT RATE

The covariance of the project's expected returns with the expected general rate of inflation must also be in nominal terms. Again, both terms are usually presented in nominal terms; thus, no adjustment is required. This covariance parameter is project specific as well. This term, in addition to the $cov(j_n,r_{m,n})$, introduces project specific factors into the calculation of the discount rate. It is not likely that a project's return and the general rate of inflation will be independent; as a result, this covariance term will play a crucial role in the calculation of the project's appropriate discount rate.

The covariance of the market's return with the general rate of inflation is the third term to be considered. Again, this general market parameter must be calculated in nominal terms. Theoretically, one might expect a positive relationship to exist between these two components. Empirical evidence suggests a slightly negative correlation exists. [7:30] Therefore, it seems reasonable to suggest this covariance could be relevant to the discount rate calculation. Some authors have suggested that one should adjust the risk premium upward for inflation risk. By analyzing the adjusted discount rate, it becomes apparent that the risk premium adjustment could be positive or negative. If the covariance of the project's returns with the rate of inflation is positive, it is possible that the risk premium should be reduced. [3:86]

If there is a positive covariance between the market's return and the general rate of inflation, the market price of risk could be overstated; as a result, the discount rate required for project j would be overstated. Each of the covariance terms must be individually analyzed to determine the appropriate discount rate.

NET PRESENT VALUE MODEL RESTATED FOR INFLATION

When each of the adjustments to the cash flows and the discount rate are made and incorporated into the traditional net present value model, it is expressed:

Without risk considerations, the denominator of the net present value model could be written:

$$\prod_{n=1}^{i} (1+\dot{p}_n)\ (1+r^{**})^n \qquad (4)$$

where p_n is the expected rate of inflation at time n, and r^{**} is the real risk free rate.

Either of the above denominators could be appropriate to use in the net present value model if no explicit recognition of risk is desired. The risk of a project, however, can be considered implicitly or explicitly recognized in the net present value model. The discount rate adjusted for project risk is

$$r_j = r^* + P_j = r^* + b_j\ (\bar{r}_m - r^*), \qquad (5)$$

where P_j is the risk premium calculated for project j specifically, b_j is the risk associated specifically with project j, and r_m is the expected return of the market portfolio. [7:14] The term b_j must be stated in nominal terms since a nominal discount rate is to be calculated. Thus, the calculation involves the determination of how project j's nominal returns vary in relation to the overall nominal market returns. The market price of risk $(r_m - r^*)$ must also be calculated in nominal terms. These considerations will be provided for in Equation (6) which follows.

Inflation risk is the risk that the dollars generated in the project may not purchase the same goods they were expected to purchase. This inflation risk should be recognized when attempting to determine the appropriate risk premium to incorporate into the discount rate. Under certain inflation the calculation of the discount rate can be adjusted to [6:1281]

$$r_{j,n} = r_n^* + \mathrm{cov}_n(\dot{p}_n, j_n) + \left[\mathrm{cov}_n(j\ r_m) - \frac{\mathrm{cov}_n(\dot{p}_n, j)}{a_n}\right] \cdot \left[\frac{r_{m,n} - r_n^* - \mathrm{cov}_n(\bar{r}_m, \dot{p}_n)}{{}_n^2(\bar{r}_m) - \frac{\mathrm{cov}_n(r_m, p_n)}{a_n}}\right] \qquad (6)$$

where

$\mathrm{cov}_n(p_n, j)$ is the covariance of project j's expected nominal return with the expected general rate of inflation at time n,

$\mathrm{cov}(r_{m,n}, p_n)$ is the covariance of the expected overall nominal market return with the expected general rate of inflation at time n,

In effect, each real cash flow, CI_i, or CO_i, is transformed into a nominal, future period, cash flow by the specific price level index corresponding to that cash flow.

The next term in the NPV model (Equation (1)) is the depreciation tax-saving term. Depreciation expense, D_i, is not a cash flow itself, but generates a tax savings. Depreciation expense is determined at the time of investment. The expense remains constant regardless of inflation, and as a result, the tax savings also remains constant. Therefore, the term, D_i t, remains unchanged in the inflation adjusted net present value model. The depreciation tax savings is stated in future period, nominal dollars without a specific price level adjustment.

If the specific price level indices are highly correlated with the general rate of inflation, a simplification would eliminate the specific indices and replace these indices with the general inflation index, p_n. Thus, substitution would simplify the equation (2) to

$$\sum_{i=1}^{T} \left[\left[\prod_{n=1}^{i} (1+p_n) \right] [CI_i - CO_i] \right] (1-t) \quad . \quad (3)$$

Once the nominal cash flows (including tax effects) have been presented, they should be discounted by the appropriate discount rate to find a present value. The prediction of an appropriate discount rate is discussed in the next section.

NOMINAL DISCOUNT RATE

To be internally consistent, the nominal cash flows must be discounted by a nominal discount rate. One possible nominal discount rate is the risk free rate (r^{**}) usually assumed to be the market rate on one year government securities. The nominal rate is the sum of the real risk free rate (r^{**}) the rate of inflation (p) and the cross-product of the real risk free rate and the inflation rate:

$$(1 + r^{**}) (1 + p) - 1 = r^{**} + p + r^{**} p.$$

The inflation rate (p) is the general rate of inflation. It is defined as the ratio of the change in general price-level (GPL) from time i-1 to the general price-level for time i such that

$$p = \frac{gpl_i}{gpl_{i-1}} - 1.$$

In the previous paragraph, the inflation rate was assumed to be constant; however, this general rate of inflation is not expected to be invariant with respect to time. Therefore, one should expect the general infation rate to vary over time in the same manner as the specific price level varies. The notion p would become p_n to denote the general rate of inflation at time n.

THE CASH FLOW INFLATION ADJUSTMENTS

In applying the net present value model, the implicit assumption is usually made that the purchasing power of the dollar is constant, or there is no inflation. In such a case, the firm is maximizing real wealth and when the net present value of a project is greater than zero, it represents and increase in real wealth. In time of general inflation, such an assumption is no longer valid and real wealth increases may not be signaled by a net present value greater than zero. A positive nominal (not adjusted for inflation) net present value for a project may represent a real wealth loss because of general inflation. The increase in general inflation causes a decline in the purchasing power of the dollar. The dollars expected in future periods will not purchase the same amount of goods as in this current period. This change in the purchasing power of the dollar should be considered when evaluating an investment opportunity.

Cash flow predictions should also reflect the real cash flow to be received in future periods. The prediction of a general price level change of today's prices, and the application of this index to all future cash flows, may not be sufficient to avoid project distortion. In fact, specific price level changes can occur simultaneously with no change in the general purchasing power of the dollar. Specific price level changes can affect the cash inflow and outflow differentially. These specific inflation effects can vary over time as well. The recognition of these specific inflation effects across time periods is warranted to avoid distortions in the project analysis. This issue will be reviewed in Chapter Three.

To incorporate relative price changes into the NPV model (Equation (1)), define I_i and O_i to be the specific price level (SPL) index affecting the i period cash inflows and outflows, respectively. Each I_i and O_i is a ratio of the change in the SPL from time i-1 to time i such that the ratio is

$$\left(\frac{spl_i}{spl_{i-1}} - 1\right).$$

The specific price level index affects a specific cash flow of the investment being analyzed.

When each real time zero cash flow is adjusted for its specific price level change, the expression

$$\sum_{i=1}^{T} (CI_i - CO_i)(1-t)$$

is replaced by the expression

$$\sum_{i=1}^{T} \left[\left[\prod_{n=1}^{i} (1+I_n)\right] CI_i - \left[\prod_{n=1}^{i} (1+O_n)\right] CO_i\right](1-t) \qquad (2)$$

Chapter Two

THEORETICAL CAPITAL BUDGETING FOR INFLATION

THE NET PRESENT VALUE MODEL

Most large firms are now utilizing a discounted cash flow model to assess the profitability of proposed projects. [11:281] For that reason, this chapter will use the net present value (NPV) model as a basis for adding explicit consideration of inflation to a capital budgeting decision.

The version of the NPV model used in this paper is

$$NPV_j = -C_o + \frac{\sum_{i=1}^{T} (CI_i - CO_i)(1-t) + D_i t}{(1 + r^* + P_j)^i} \qquad (1)$$

where

C_o is the cash outflow at time zero, or investment, $C_o \quad 0$

CI_i, CO_i are the expected cash inflows and outflows at time i

t is the tax rate

D_i is the depreciation expense at time i

r^* is the risk-free interest rate

P_j is a risk premium for project j

In the absence of inflation, a manager should accept the project with the greatest positive net present value. When inflation exists, ambiguities arise in predicting both the cash flows (the numerator in equation (1)) and the appropriate discount rate (the denominator in equation (1)). This chapter discusses both prediction areas and develops an inflation-adjusted net present value model.

these rates as well (See Table 1). Since inflation not only increases the complexity of a decision, but the unfamiliarity associated with it as well, the Beach and Mitchell model was used to show that inflation should be incorporated into an analytical model. Finally, the literature was reviewed to show that limited consideration has been given to this concept. The theoretical considerations of an inflation adjusted capital budgeting model will be examined in greater detail in the next chapter.

review to sort and evaluate relevant economic factors. Since inflation may affect different phases of a specific project differently, the analysis could become far more complicated than the addition of a single factor.

Inflation may affect not only the level of complexity, but the level of unfamiliarity as well. Unfamiliarity is the degree to which the problem is foreign to the decision maker. Granted, a manager who makes only investment decisions is relatively familiar with this decision; but, the introduction of inflation into the decision problem reduces the familiarity of the manager with that specific decisi n. Since high inflation is relatively new and only recently being considered in the decision problem, the unfamiliarity with the problem is increased.

The Beach and Mitchell model then suggests that the increase in the level of these factors requires a more sophisticated (aided analytic) capital budgeting model. At least two factors of the model have increased; thus, the level of model sophistication may also increase. In this instance, the manager could change from an implicit inflation adjustment (as was the case in the early 1970s) to an explicit inflation adjustment in his capital budgeting model.

MODEL CONSIDERATIONS

In addition to the increased environmental complexity caused by inflation and the resulting complexity of the decision problem for the manager, there has been an increase in discussion of potential inflationary effects on the firm and the availability of possible inflation adjusted models. For example, Cooley, Roenfeldt and Chew developed several inflation adjusted net present value models that managers might utilize in their investment decisions. (3:84) Raiborn and Ratcliffe assert that managers should incorporate inflation into their investment decisions by utilizing a general inflation adjusted net present value model. [10:22] Friend, Landskroner and Losq assert that the traditional capital asset pricing model (CAPM) (unadjusted for inflation) understates the market price of risk if there is unexpected infation and there exists a positive covariance between the market rate of return and the rate of inflation. [6:1296] If under expectations of uncertain inflation and a positive covariance between an asset's rate of return and the rate of inflation exits, then the traditional CAPM overstates the risk of an asset. The manager may decide to consider these normative model strategies when determing what capital budgeting strategy should be utilized. Further discussion of these factors will take place in Chapter Two.

SUMMARY

A review of the literature shows that inflation was only implicitly considered in capital budgeting models during the early 1970s. However, one must now ask if this factor needs to be explicitly considered given not only the high rates of the recent past, but the more extreme fluctuations in

UNITED STATES HISTORICAL INFLATION INDICES
(Base Year FY 85)
(As of 30 January 84)

Fiscal Year	GNP Deflator Index	GNP Deflator %	CPI-U 1/ Index	CPI-U 1/ %	WPI 2/ Index	WPI 2/ %
1950	.224	-	.219	-	.236	-
1951	.239	6.7	.232	5.9	.269	14.0
1952	.246	2.9	.243	4.7	.271	0.7
1953	.250	1.6	.246	1.2	.266	- 1.8
1954	.253	1.2	.249	1.2	.266	0.0
1955	.257	1.6	.247	-0.8	.265	- 0.4
1956	.264	2.7	.248	0.4	.270	1.9
1957	.274	3.8	.256	3.2	.279	3.3
1958	.280	2.2	.264	3.1	.285	2.2
1959	.286	2.1	.268	1.5	.287	0.7
1960	.292	2.1	.271	1.1	.287	0.0
1961	.295	1.0	.275	1.5	.287	0.0
1962	.300	1.7	.278	1.1	.286	- 0.3
1963	.304	1.3	.381	1.1	.287	0.3
1964	.309	1.6	.285	1.4	.287	0.0
1965	.315	1.9	.289	1.4	.289	0.7
1966	.323	2.5	.295	2.1	.298	3.1
1967	.333	3.1	.304	3.1	.303	1.7
1968	.345	3.6	.314	3.3	.306	1.0
1969	.362	4.9	.329	4.8	.316	3.3
1970	.382	5.5	.349	6.1	.329	4.1
1971	.401	5.0	.367	5.2	.339	3.0
1972	.419	4.5	.380	3.5	.352	3.8
1973	.438	4.5	.396	4.2	.380	8.0
1974	.470	7.3	.431	8.8	.441	16.1
1975	.517	10.0	.479	11.1	.516	17.0
1976	.553	7.0	.513	7.1	.543	5.2
1977	.591	6.9	.551	7.4	.580	6.8
1978	.630	6.6	.590	7.1	.620	6.9
1979	.685	8.7	.651	10.3	.690	11.3
1980	.745	8.8	.739	13.5	.790	14.5
1981	.818	9.8	.821	11.1	.876	10.9
1982	.876	7.1	.882	7.4	.903	3.1
1983	.913	5.6	.913	5.0	.914	1.2
1984 3/	.954	5.0	.955	4.4	.953	4.3
1985 3/	1.000	4.8	1.000	4.7	1.000	4.9

Footnotes:

1/ The CPI-U is the Consumer Price Index for all urban consumers. It covers approximately 80% of the civilian population.

2/ The WPI is the Wholesale Price Index, also now called the Producer Price Index.

3/ 1984 and 1985 Estimated.

Data Source: The Air Force Budget Fiscal Year 1983, p. A8.

TABLE 1

RESULTS OF SURVEY

What can be concluded from this limited survey data is that in the retail industry, inflation is "explicitly" recognized in the capital budgeting process by means of specific price level indices applied against future period cash flows only. No consideration is given to adjusting the discount rate for the risk associated with inflation. This factor is substantiated by the indication that no inflation risk premium is added nor have the results of inflation forced a change in investment decision strategies.

From a practical standpoint then, the retail industry (as represented by the three firms surveyed) only adjusts the capital budgeting model for the effects of inflation by means of Equation (3) and no effect is given to the theoretical implications raised by Equations (4) and (5). Therefore, the theoretically correct Equation (7) is not used in practice, but rather the following inflation adjusted NPV capital budgeting model would apply to the retail industry.

$$NPV = -C_0 + \sum_{i=1}^{I} \frac{\left[\left[\prod_{n=1}^{i}(1 + \dot{P}_n)\right][CI_i - CO_i]\ (1 - T)\right] + D_i T^*}{(1 + r^* + P_j)^i = r_j^i} \quad (8)$$

SUMMARY

IF AAFES is to consider the effects of inflation the way three of the major leading retailers in this country do, then it must ensure the use of specific price level indices on future cash flows and it need not give consideration to the theoretical aspects that center around adjusting the discount rate for specific risk associated with changing inflation rates. Although this may allow AAFES to be in step with its competition from an empirical standpoint, it does not mitigate the problems discussed in Chapter Three that may befall a firm if all the effects of inflation are not properly considered. For example, a wrong investment decision could be made if the proper price index was not selected or the risk associated with price level changes was ignored. However, the effort associated with using the theoretically correct inflation adjusted NPV model may exceed the benefits from the improved decision signal obtained from this model. This may be why the retail industry has opted to consider only the cash flow aspects associated with inflation and to ignore the inflation risk factors raised in Chapters Two and Three when making capital budgeting decisions.

Chapter Five

CONCLUSION

The purpose of this research has been to analyze why and how the effects of inflation should be considered in a capital budgeting framework. Great effort was made to analyze the theoretical suppositions involved with such an undertaking. In addition a limited empirical review was performed to compare these theoretical suppositions with what was actually happening in an area that could have relevance to an Army and Air Force entity such as the Army and Air Force Exchange Service.

The theoretical basis of this report was substantiated by Chapters One, Two and Three. This work allowed for a complete literature review on this subject and supported what the effects of inflation on an investment decision should entail. The second phase of this study was documented in Chapter Four and showed that as far as the retail industry was concerned only a limited portion of the theoretical doctrine developed in the first phase of the report was actually applied in practice.

As a final summary, if one wished to condense this entire review concerning the effects of inflation on the capital budgeting decision process, the following would be the author's one-line description:

"Although it may be sound theoretically, it may not necessarily be applied in practice."

BIBLIOGRAPHY

A. REFERENCES CITED

Books

1. Carsbert, B and A. Hope. Business Investment Decisions Under Inflation. The Institute of Chartered Accountants in England and Wales, 1976.

Articles and Periodicals

2. Beach, Lee Roy and Terence R. Mitchell. "Contingency Model for the Selection of Decision Strategies," Academy of Management Review, (July 1978): pp 439-449.

3. Cooley, P. L., R. H. Roenfeldt and I. K. Chew. "Capital Budgeting Procedures Under Inflation," Financial Management, (Autumn 1976): pp 83-90.

4. Fama, Eugene F. and G. W. Schuert. "Inflation, Interest and Relative Prices," Journal of Business, (April 1979): pp 183-209.

5. Fremgren, James T. Capital Budgeting Practice: A Survey," Management Accounting, (May 1973): pp.19-25.

6. Friend, I., Y. Landskroner and E. Losq. "The Demand for Risky Assets Under Uncertain Inflation," Journal of Finance, (December 1976): pp 1287-1297.

7. Hamada, R. S. "Portfolio Analysis, Market Equilibrium and Corporation Finance," Journal of Finance, (March 1978): pp 13-30.

8. Mao, James C. T. "Survey of Capital Budgeting Theory and Practice," Journal of Finance, (May 1970): pp 349-360.

9. Nelson, C. R. "Inflation and Capital Budgeting," Journal of Finance, (June 19760: pp 923-932.

10. Raiborn, O. D. and T. A. Ratcliffe. "Are You Accounting for Inflation in Your Capital Budgeting Process?" Management Accounting, (September 1979): pp 19-22.

CONTINUED

11. Schall, L., G. Sundem and W. Geijsbeek. "Survey and Analysis of Capital Budgeting Models," Journal of Finance, (March 1978). pp 281-287.

B. RELATED SOURCES

Books

Copeland, T. E. and J. F. Weston, Financial Theory and Corporate Policy. Massachusetts: Addison-Wesley Publishing Company, Inc., 1979.

Haley, C. W. and L. D. Schall. The Theory of Financial Decisions. New York: McGraw-Hill, Inc., 1973.

Articles and Periodicals

Burkett, Ronald L. "Recognizing Inflation in the Capital Budgeting Decision," Management Accounting, (November 1971): pp 40-46.

Klammer, T. "Empirical Evidence of the Adaptions of Sophisticated Capital Budgeting Techniques," Journal of Business, (July 1972): pp 387-397.

Mehler, E. W. "Capital Budgeting: Theory and Practice," Management Accounting (September 1976): pp 32-38.

APPENDIX ONE

SURVEY INSTRUMENT

The follow survey is being used to assess overall capital budgeting technique across several different industries for a related project I am researching. For purposes of this Air Command and Staff College Report only, the questions dealing with the effects of inflation on the capital budgeting process were analyzed. The results of the analysis and which firms responded are summarized in Appendix Two.

1. For what decisions do you use capital budgeting techniques?

   All investments

   For all investments over $_____

   For certain investments. Please explain.

2. For what percentage of total corporate capital investment expenditures are capital budget techniques applied?

3. What form do these capital budgeting techniques take? Please check all applicable techniques and place a "1" after your primary technique and a "2" after the secondary technique, etc.

   Pay Back

   Internal Rate of Return

   Discounted Present Value of Cash Flow

   Accounting Rate of Return

   Other, please explain.

4. Is inflation explicitly recognized in your capital budgeting decision?

No

Yes for all projects

Yes for some specific projects. Please explain.

If yes, during what year did this recognition begin?_____

If yes, has the method of inflation recognition been modified over time?

No

Yes, please explain.

5. How do you calculate cash flow estimates for the projects under consideration?

Current period dollars (constant dollars, all cash flows stated in today's dollars regardless of date of cash flow)

Current period dollars adjusted by a specific price level index

Current period dollars adjusted by a general price level index

Other, please explain.

6. What sources do you use for: (Write N/A is not applicable)

General Price Level Index_____

Specific Price Level Index_____

7. What discount rate do you use when making investment decisions?

Weighted average cost of capital of debt and equity

Real rate of interest

Real rate of interest plus a project risk premium

Market rate of interest

Market rate of interest plus a project risk premium

Market rate plus project risk premium plus inflation risk premium

Market rate plus inflation risk premium

Other

Please explain the calculation procedure and perhaps include an example.

8. Is the discount rate used the same for all projects under consideration?

Yes, it is the same for all projects regardless of associated risk

It is the same for all projects within a specific risk class

It is specific for each project under consideration

9. What discount rate do you use in investment decision?_____

10. What factors do you consider when determing the overall riskiness of a project?

Do you explicitly consider the uncertainty about the rate of inflation (inflation risk)?

Yes

No

Is inflation risk explicitly distinguished from overall project risk?

No

Yes, please explain.

11. Which of the following statements most fairly represents you attitude toward risk?

Inflation risk is relatively more important than the risk elements discussed in question 10.

Inflation risk has the same level of importance as the elements discussed in question 10.

Inflation risk is relatively less important than those elements discussed in question 10.

Please make any additional comments about inflation risk in the space provided.

12. Do you attempt to distinguish those projects whose revenues and expenses are relatively constant from those projects whose revenues and expenses vary as the rate of general inflation varies?

No

Yes, please explain.

If yes, what explicit consideration is made in the investment decision after the project is distinguished?

13. Do you determine an inflation risk premium in investment decisions?

Yes, and inflation risk premium is calculated and used in evaluating all projects.

No inflation risk premium calculated and used

If yes, please explain the calculation procedure.

14. What procedures do you utilize to counter the inflation risk associated with a given return for a specific project? (Check as many boxes as applicable)

Shorten the planning horizon of a project

Lengthen the planning horizon of a project

Implement multi-purpose projects

Implement single purpose projects

Implement stage projects

Implement capital intensive projects

Implement labor intensive projects

Defer replacement of equipment

Install equipment that is in excess of demand

Other, please explain.

15. Soley as a result of inflation, have any of the procedures in question 14 been modified?

No

Yes, please explain.

If yes, has the procedure modification been uniform for all projects?

The modification has been uniform for all projects.

The modification has been made dependent upon each projects characteristics.

16. As a result of inflation, has your firm modified any phase of operations that has not been covered in question 1 to 15?

No

Yes, please elaborate further.

APPENDIX TWO

RETAIL INDUSTRY RESPONSES TO HOW INFLATION IS ACCOUNTED FOR IN THE CAPITAL BUDGETING PROCESS

For purposes of this report, only retail industry firm responses to inflation related questions from the survey in Appendix One are compiled in this appendix. The survey instrument was sent to each commercial firm listed in Table 2 of this report. The following is the result of the responses of three of the top seven firms.

Question Number 4 - Is inflation explicitly recognized in your capital budgeting decisions?

K-MART - Yes

J. C. PENNY - Yes

WOOLWORTH'S - Yes

Question Number 5 - How do you calculate cash flow estimates for projects under consideration?

Note: All firms responded: Current period dollars adjusted by specific price level indexes.

Question Number 7 - What discount rate do you use when making investment decisions?

Note: All firms responded: Weighted average cost of capital of debt and equity.

Question Number 10 - Do you explicitly consider the uncertainty about the rate of inflation (inflation risk)?

Note: All firms responded No.

Question Number 13 - Do you determine an inflation risk premium in investment decisions?

K-MART - No

J. C. PENNY - No

WOOLWORTH'S - Yes

Question Number 16 - As as result of inflation has your firm modified any phase of operation that has not been covered in questions 1 to 15?

K-MART - No

J. C. PENNY - No

WOOLWORTH'S - No

END

FILMED

8-85

DTIC